

Effect of submucosal administration of dexamethasone on postoperative discomfort after third molar surgery

ABSTRACT

Aim: To compare the impact of submucosal dexamethasone (4 mg) administered after the onset of local anesthesia on postoperative discomfort after third molar surgery and compare the parameters with a control group that did not receive the drug.

Methods: A total of 60 patients indicated for surgical removal of impacted mandibular third molars (mesioangular, Class II or III, and position B or C) were randomly divided into two groups of 30 patients each. After the onset of local anesthesia, the first group (Group A) received a submucosal injection of 4 mg dexamethasone adjacent to the surgical site, and the control group (Group B) received no drug. Pain, swelling, and trismus were recorded at follow-up visits on the 1st, 2nd, and 7th postoperative days. Assessment of postoperative discomfort was performed by evaluating responses through a modified postoperative symptom severity scale questionnaire, which was administered to the patients on the 7th postoperative day.

Results: The difference in subjective pain values and the mean number of analgesics consumed was not significant between the groups. The difference in postoperative swelling was statistically significant on the 1st, 2nd ($P < 0.0001$), and 7th postoperative days ($P = 0.0152$). The difference in postoperative trismus was highly significant on 1st and 2nd postoperative days ($P < 0.0001$). The difference in the mean total quality of life (QOL) score, Eating, Appearance, Daily activity subscale ($P < 0.0001$), and Social Isolation subscale ($P = 0.0002$) was statistically significant between both groups.

Conclusion: It was found that the administration of submucosal dexamethasone resulted in significantly lesser postoperative swelling and trismus and better QOL outcomes.

Keywords: Dexamethasone, impacted third molar, postoperative pain, quality of life (QOL), surgical removal, swelling, trismus

INTRODUCTION

Impacted third molar removal involves surgical trauma in a highly vascular area and often results in inflammatory sequelae that peak 1–3 days after the surgery.^[1,2] Postoperative pain, swelling, and trismus adversely affect the physical, psychological, social, and general well-being of the patient. The postoperative discomfort may be evaluated as the quality of life (QOL). It is a multidimensional concept and is described as a patient's perception of his position in life, which is the effect of disease and treatment. It has gained extensive importance because subjective outcomes are significantly different and more effective than objective testing or surgeon-rated scores.^[3-5]

To minimize the immediate inflammatory response associated with third molar surgery many methods such as


administration of analgesics, corticosteroids, antibiotics, laser application, drains, and piezosurgery are proposed in the literature.^[6] The administration of corticosteroids is a pharmacological method that aims to suppress the body's

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Received: 06 January 2023, **Revised:** 12 May 2023
Accepted: 20 May 2023, **Published:** 24 July 2024

Access this article online	
Website: www.njms.in	Quick Response Code 
DOI: 10.4103/njms.njms_4_23	

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How to cite this article: Sharma D, Mishra Tripathi G, Tiwari R, Mishra A. Effect of submucosal administration of dexamethasone on postoperative discomfort after third molar surgery. Natl J Maxillofac Surg 2024;15:288-94.

inflammatory response to injury and minimize postoperative complications.^[7,8]

Many studies in the literature have concluded that the use of steroids imparts consistent results in the improvement of postoperative swelling after third molar removal; however, variable findings have been reported with regard to trismus and pain. The aim of this prospective, randomized, control trial was to assess the effect of preoperative administration of 4 mg submucosal dexamethasone on postoperative pain, swelling, and mouth opening, evaluate its effect on QOL after third molar surgery, and compare it with a control group that did not receive dexamethasone.

MATERIALS AND METHODS

A prospective randomized control study was conducted on patients who reported to the Department of Dentistry associated with a medical college, for the removal of an impacted third molar from February 2021 to February 2022. Ethical clearance was obtained from ethical committee of SSMC, Rewa with reference number IEC/MC/2020/466 dated 8/01/2021. It was conducted in accordance with the Helsinki Declaration of 1964 and later versions, and written informed consent for participation in the study was obtained from all patients.

Study population and sampling

The inclusion criteria were asymptomatic bony impacted mandibular third molars that were classified as mesioangular, Class II or III, position B or C impaction according to the Pell and Gregory classification and could be removed under local anesthesia. The exclusion criteria were impacted teeth with acute pericoronitis, periapical or periodontal disease, pregnant or lactating women, patients with a history of allergy to the drugs used in the study, systemic diseases or syndromes, patients who reported recent use of anti-inflammatory drugs or antibiotics, patients unwilling for participation in the study, and patients who were lost to follow-up at scheduled visits. Cases with surgery duration of more than 45 min were also excluded to eliminate the confounding effect of prolonged surgery on postoperative discomfort. Patients with temporomandibular joint disorders were not included because it has been suggested in the literature that third molar surgery worsens the disease.^[9,10]

Sample size

A sample size of 60 was taken (30 in the test and control group each) to detect the difference of 40% between the groups for relief in postoperative discomfort with 90% power and a 5% significance level. We assume the “relief in postoperative discomfort” in the control and test groups to be 25% and

65%, respectively. The sample size was calculated using the following formula:

Formula:

$$n = \frac{\left\{ Z_{1-\alpha/2} \sqrt{2\bar{P}(1-\bar{P})} + Z_{1-\beta} \sqrt{P_1(1-P_1) + P_2(1-P_2)} \right\}^2}{(P_1 - P_2)^2}$$

$$\text{Where, } \bar{P} = \frac{(P_1 + P_2)}{2}$$

P_1 : Proportion in the first group ;

P_2 : Proportion in the second group

$Z_{1-\alpha/2}$: Significance level

$Z_{(1-\beta)}$: Power

Surgical procedure

Routine blood investigations and intraoral periapical radiographs (IOPAR) were obtained for all patients. A 2% solution of lignocaine hydrochloride and adrenaline 1:80000 was administered for the inferior alveolar nerve block and long buccal nerve block. After the onset of local anesthesia, the experimental group (Group A) received a 4 mg submucosal dexamethasone injection in the buccal vestibule in proximity to the surgical site, and the control group (Group B) received no drug. An incision was made from the distal surface of the mandibular second molar extending to the distal part of the mandibular third molar with mesial and distal relieving incisions. The trapezoid flap was raised with a Howarth periosteal elevator. The flap was carefully protected with an Austin tissue retractor. Bucco-distal bone removal around the tooth was performed with a round bur on a straight handpiece under continuous irrigation. If necessary, sectioning of the crown and/or roots was performed with a fissure bur. After tooth removal, the surgical site was copiously irrigated, bony spicules were removed, and closure was performed with two interrupted 3-0 silk sutures, one placed just distal to the lower second molar and one placed distally. The duration of the operation was the time elapsed between the incision and the placement of the last suture. The surgical removal of all impacted third molars was carried out by two oral and maxillofacial surgeons (both had a minimum clinical experience of more than 7 years), with one of them functioning as the main surgeon and the other as the assistant surgeon on rotation. Protocols of asepsis, patient preparation, flap exposure and handling, management of hard tissues, application of controlled force with surgical instruments, and hemostasis were strictly followed by both surgeons.

All postoperative instructions were explained to the patient including pressure pack application for 30 min and ice pack

application for 20 min. Amoxicillin 500 mg capsule three times a day for 5 days and ibuprofen 400 mg tablets were also prescribed. Patients were instructed to take the prescribed analgesic when they felt that the pain had reached moderate intensity and record the time and the number of analgesic tablets that he/she had to take until the 7th postoperative day.

Pre and postoperative clinical assessment

Pain assessment was performed by interpretation on a 10-cm visual analog scale (VAS) with marking thoroughly explained to the patient as 0 cm for no pain, 5 cm for moderate pain, and 10 cm for unbearable pain. Facial contour was evaluated as the sum of distances of two lines across four reference points from the lateral canthus to the angle of the mandible and from the tragus to the corner of the mouth measured with a 3-0 silk suture and measuring tape.^[11,12] [Figure 1] The facial swelling was recorded as the difference between preoperative (baseline) and postoperative values. Mouth opening was measured as the maximum inter-incisal distance measured by a metal ruler. Trismus was measured as the difference in inter-incisal distance at the maximal mouth opening before and after surgery at follow-up. The assessments were performed preoperatively and postoperatively after 24 h, 48 h, and on the 7th day by an examiner who was blinded to the administration of test medication. Postoperative difficulty in removing third molars was classified according to the Modified Parant scale because it is considered to be relatively more reliable than the Pederson scale.^[13,14] The measurement of patients' postoperative discomfort (QOL) was based on a modified postoperative symptom severity scale questionnaire (adapted from previous studies in literature), which was administered to the patients on the 7th postoperative day through face-to-face interviews by a single investigator.^[5,15] The questionnaire assessed the

postoperative discomfort of the patients through 15 questions under six categories that were likely to be affected (eating, speech, appearance, sleep, interference with daily activities, and social isolation). They were instructed to answer the questions by responding on a 4-point scale (0-not at all to 3-very much), and the total score ranged from 0 to 45 with a score of 45 depicting the most severe impairment in the QOL following extraction of the third molar tooth [Figure 2].

Statistical analysis

Data are expressed as mean ± standard deviation (95% confidence interval), or as numbers and percentages. The analysis of pain, trismus, and swelling on postoperative days 1, 2, and 7, and the QOL subscale scores and summative QOL scores between both groups was performed using the unpaired *t*-test. A *P* value of less than 0.05 was considered statistically significant.

RESULTS

A total of 60 individuals were included in the final analysis. The mean age (± standard deviation) was 31.83 ± 9.18 years with a range of 19–54 years. The male-to-female ratio was 1.14:1 with 32 (53.33%) males and 28 (46.67%) females [Table 1]. The distribution of patients according to the classification of impaction in terms of angle of impaction, position relative to the ramus of the mandible, and depth of impaction is presented in Table 1. The difficulty of removal of third molars was assessed through the modified Parant scale [Table 2]. The difference in the duration of surgery was not statistically significant in both groups [Table 3]. Postoperative pain and trismus were

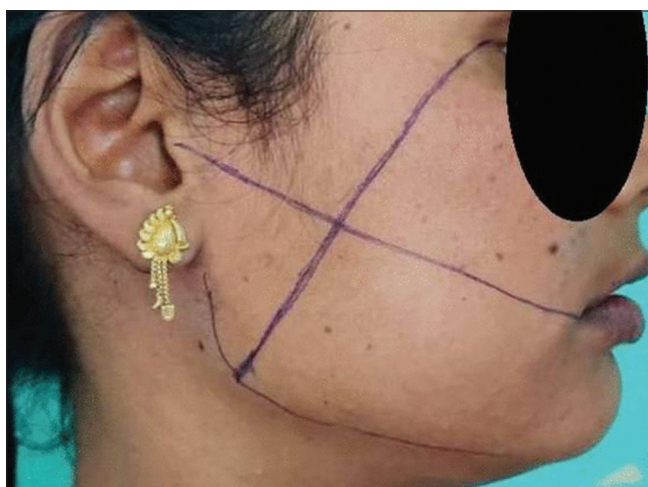


Figure 1: Facial contour measurement. (Sum of distances of two lines across 4 reference points from lateral canthus to the angle of the mandible and from the tragus to the corner of the mouth)

Table 1: Distribution of patients according to demographic characteristics and classification of impacted mandibular third molars

Variable	Group A (n=30) No. of patients (n)	Group B (n=30) No. of patients (n)	Total (n=60) No. of patients (n) (%)
Gender			
Male	15	17	32 (53.33%)
Female	15	13	28 (46.67%)
Age (in years)			
18-20	02	02	04 (6.67%)
21-30	13	11	24 (40.00%)
31-40	10	11	21 (35.00%)
41-50	04	04	08 (13.33%)
51-60	01	02	03 (5.00%)
Class of impaction			
Class II	14	13	27 (45.00%)
Class III	16	17	33 (55.00%)
Depth of impaction			
Position B	14	15	29 (48.33%)
Position C	16	15	31 (51.67%)

Questionnaire		Patient's perception at 7 th post operative day				Duration for which the subscale was affected (in Days)
		Not at all (Score: 0)	Slight (Score:1)	Quite a lot (Score:2)	Very much (Score:3)	
A. Eating Subscale					 Days
1	Were dietary modifications required?					
2	Effect on ability to chew					
3	Effect on ability to swallow					
4	Effect on food enjoyment/taste					
5	Was ability to open the mouth affected?					
Total Subscale score /15						
B. Speech Subscale					 Days
6	Did you notice a change in voice?					
7	Was your ability to talk affected?					
Total Subscale score /6						
C. Appearance Subscale					 Days
8	Have you experienced a change in facial appearance					
Total Subscale score /3						
D. Sleep Subscale					 Days
9	Have you experienced problem in sleep					
10	Did you suffer from dizziness					
Total Subscale score /6						
E. Daily activities					 Days
11	Inability to pursue daily household activities					
12	Inability to pursue hobbies					
13	Inability to attend work place					
14	Inability to fulfill professional commitments					
Total Subscale score /12						
F. Social Isolation Subscale					 Days
15.	Adverse effect on social interaction					
Total Subscale score /3						
TOTAL QOL SCORE /45						

Figure 2: Modified postoperative symptom severity (PoSSe) scale questionnaire that was administered to the patient on the 7th postoperative day to assess the postoperative quality of life

Table 2: Distribution of patients according to postoperative modified Parant surgical difficulty scale

Rating according to modified Parant surgical difficulty scale	Group A (n=30) No. of patients (n)	Group B (n=30) No. of patients (n)
Type I (easy) (extraction required forceps)	0	0
Type II (easy) (extraction required osteotomy)	7	10
Type III (difficult) (extraction required osteotomy and coronal section)	14	12
Type IV (difficult) (complex extractions requiring osteotomy and root section)	9	8

Table 3: Comparison of duration of surgery in both groups (duration in minutes; unpaired t-test used to analyze data)

Variable	Group A (n=30) Mean±SD	Group B (n=30) Mean±SD	P
Mean duration of surgery	32.7±4.71	33.53±5.01	0.511

the greatest in both the groups on first day after surgery and gradually decreased subsequently until the 7th postoperative

day, whereas swelling was the maximum on 2nd postoperative day [Table 4]. The difference between the mean values of pain was not statistically significant on any of the follow-up days. The difference in postoperative swelling was statistically significant on the 1st and 2nd postoperative days ($P < 0.001$) and on the 7th postoperative day ($P = 0.01$). The difference between mean values for trismus between the groups on the 1st and 2nd postoperative days was found to be highly statistically significant ($P < 0.0001$); however, on the 7th postoperative day, the difference between the groups was not significant [Table 4].

None of the patients had to take analgesics after the 4th day in Group A and after the 5th day in Group B. The mean number of analgesics taken by patients in both groups was not statistically significant [Table 5]. Alveolar osteitis, postoperative wound infection, damage to adjacent teeth, and permanent nerve injury were not reported in any patient.

Submucosal administration of 4 mg dexamethasone before the third molar surgery showed statistically significant differences in all subscales of QOL, except for the speech and

Table 4: Comparison of mean values of pain, swelling, and trismus between both groups (Unpaired t-test used to analyze data)

Postoperative day	Pain (mean±SD)			Swelling (mean±SD)			Trismus (mean±SD)		
	Group A (n=30)	Group B (n=30)	P	Group A (n=30)	Group B (n=30)	P	Group A (n=30)	Group B (n=30)	P
Day 1	4.47±0.94	4.9±1.03	0.096	1.18±0.57	2.67±0.56	<0.0001	10.20±2.4	14.63±0.85	<0.0001
Day 2	3.33±0.84	3.54±0.99	0.379	1.8±0.52	3.43±0.83	<0.0001	7.83±1.18	13.2±1.24	<0.0001
Day 7	0.47±0.63	0.77±0.63	0.07	0.25±0.24	0.44±0.34	0.0152	3.97±0.72	4.13±0.63	0.363

sleep subscales [Table 6]. In the dexamethasone group, the “daily activities” and “appearance subscale” were the longest affected (> 1.5–2 days), followed by the eating subscale (> 1–1.5 days). The remaining subscales were affected for > 0.5–1 day. In group B “eating” and “appearance” subscales were affected for the longest duration (>2.5–3.5 days), followed by daily activities subscales (>2–2.5 days) [Table 7].

DISCUSSION

Dexamethasone and methylprednisolone are the preferentially used corticosteroids for reducing pain, swelling, and trismus in dentoalveolar surgery.^[16,17] They exert pure glucocorticoid effects with very limited mineralocorticoid effects and have the least adverse effects on leukocyte chemotaxis.^[18] In our study, dexamethasone was administered because it has a longer duration of action than methylprednisolone and is considered more potent.^[19] The submucosal route was preferred because it is convenient for both the surgeon and the patient, and is known to provide higher effective drug concentration at the site of injury, lesser systemic effects, and painless injection, as the area is already anesthetized.^[20,21] Intra-venous injections are invasive and technique-sensitive, and orally administered glucocorticoids are almost completely absorbed rapidly. Majid^[5] found that submucosal injection of 4 mg dexamethasone has a comparable effect to intramuscular administration on postoperative sequelae after surgical removal of impacted lower third molars. Majid and Mahmood^[22] in their study on five treatment groups who received dexamethasone 4 mg as intramuscular injection, intravenous injection, oral tablets, submucosal injection, and endoalveolar powder, and a control group that received no dexamethasone found that local routes showed comparable effect to systemic routes on swelling, trismus, and pain QOL measures.

Pre-emptive administration was chosen over postoperative administration considering that corticosteroids should be given before the onset of the inflammatory process.^[12] Grossi et al.^[23] suggested that submucosal injection of 4 mg and 8 mg dexamethasone is effective equally in terms of eliminating postoperative edema. Thus, the low-dose (4 mg) injection was preferred similar to the studies by Majid,^[5] Majid and Mahmood^[7] and Nair et al.^[20]

Table 5: Comparison of the mean number of analgesic tablets taken by patients between both groups (unpaired t-test used to analyze data)

Variable	Group A (n=30) Mean±SD	Group B (n=30) Mean±SD	P Mean±SD
Mean analgesics consumed	4.1±0.71	5.97±1.16	P<0.0001

Table 6: Comparison of mean patient scores for the QOL subscales and overall QOL score between both the groups (unpaired t-test used to analyze data)

Subscale	Group A (n=30) Mean±SD	Group B (n=30) Mean±SD	P
Eating subscale	5.97±1.05	7.47±0.92	<0.0001
Speech subscale	0.9±0.48	1.13±0.78	0.174
Appearance subscale	1.1±0.65	2.07±0.51	0.0001
Sleep subscale	1.1±0.48	1.27±0.58	0.221
Daily activities	3.4±1.01	5.67±1.29	<0.0001
Social Isolation subscale	1.17±0.53	1.8±0.70	0.0002
Total	13.7±1.58	19.4±2.04	<0.0001

Table 7: Comparison of duration of post-operative discomfort on QOL subscales (unpaired t-test used to analyze data)

Subscale	No of days for which the subscale was affected		
	Group A (n=30) Mean±SD	Group B (n=30) Mean±SD	P
Eating subscale	1.37±0.95	3.2±1.08	<0.0001
Speech subscale	0.93±0.64	1.13±0.63	0.227
Appearance subscale	1.6±0.61	2.93±1.18	<0.0001
Sleep subscale	0.9±0.61	1.1±0.55	0.187
Daily activities	1.77±0.76	2.47±0.80	0.001
Social Isolation subscale	0.97±0.84	1.43±0.76	0.0300

The mean value of VAS scores was lower in the dexamethasone group compared with the control group at all postoperative follow-ups. The difference in the VAS score was not statistically significant, which was similar to other studies in literature,^[5,12,23,24] but in contrast to studies by Majid^[7] and Nandini^[8] who found significant differences in pain values at all postoperative intervals. The mean number of rescue analgesics taken was lower in Group A, but the difference in both the groups was not statistically significant, which can be correlated with the findings that the difference in mean pain values between both groups was also not significant.

The release of prostaglandins and bradykinins during the removal of third molars alone cannot be held responsible for pain causation; otherwise, the administration of corticosteroids would have resulted in lesser pain because of the inhibition of prostanoid production. Pain causation has also been attributed to central sensitization, leading to the release of neurotransmitters from the terminals of nociceptors within the spinal cord, which is not inhibited by corticosteroids.^[12] It is discussed in the literature that a significant reduction after the administration of steroids in pain is noted 4–6 h postoperatively but not later. The non-significant difference in pain in our study could possibly be attributed to the fact that pain was recorded after 24 h of surgery and by that time the effect of corticosteroids could have diminished.^[7,25]

Corticosteroids limit the inflammatory process by inhibiting leukotrienes and prostaglandins and reducing fluid transudation and edema.^[17] The onset of facial swelling after surgical trauma was gradual, with greater mean values on the second postoperative day in both groups similar to the finding of Mojsa *et al.*^[26] The difference in the mean facial swelling on 1st, 2nd, and 7th postoperative days in both the groups was statistically significant, which was similar to the findings of Majid and Mahmood^[7] and Nandini^[8] at postoperative days 1, 3, and 7. The findings in this study were contrary to the findings of Grossi *et al.*^[23] and Deo,^[24] where no statistically significant difference was noted between the dexamethasone and control groups in the mean postoperative swelling on the 7th day.

Surgical trauma leads to edema and fluid buildup in the area of the masticatory muscles resulting in postoperative trismus. Trismus affects eating and vocal articulation in patients leading to greater postoperative discomfort.^[4] Better mouth opening in the submucosal dexamethasone group was noted at all follow-up, visits which may be a direct effect of the steroid or may be a result of reduced edema after dexamethasone administration.^[21] The difference in trismus between the groups was statistically significant only on 1st and 2nd postoperative days. In a similar study by Majid,^[5] the administration of submucosal dexamethasone provided significant improvement in trismus in comparison to the control group only on day 1 postoperatively and no significant difference at days 3 and 7, and it was attributed to the greater concentration of dexamethasone achieved immediately at the site of tissue injury. Nair *et al.*^[20] reported that postoperative trismus (evaluated at days 2 or 7) was not significant between the submucosal dexamethasone group and the control group. In contrast, Mojsa *et al.*^[26] reported significantly lesser trismus on days 2, 3, and 7 in patients who were given dexamethasone before or after the surgical procedure in comparison to the control group.

Deterioration in the QOL was observed in the immediate postoperative period following the third molar surgery in both groups.^[27,28] This finding was in accordance with the studies that reported that the QOL was affected in the majority of patients for 3–5 days after surgery.^[5,15,27]

Submucosal administration of dexamethasone 4 mg before the third molar surgery showed statistically significant differences in the mean QOL score and all subscales of QOL, except for the speech and sleep subscales. Ibikunle *et al.*,^[3] and McGrath *et al.*^[27] have reported similar findings with respect to speech subscale and explained that limited or no dissection on the lingual side results in less inflammation on the lingual side and thus unrestricted tongue movement and unaffected phonation after the surgery.^[3,27]

Majid^[5] compared the effect of 4 mg submucosal and 4 mg intramuscularly administered dexamethasone immediately after the surgery with a control group and found statistically significant differences in the total QOL score and all subscales of QOL, except for the speech subscale, whereas Grossi *et al.*^[23] compared the effect of 4 mg and 8 mg submucosal dexamethasone with the control group and found significantly better scores only on the appearance subscale.

Deo^[24] compared the effect of 8 mg submucosal dexamethasone with the control group on 7 PoSse subscales, that is, eating, speech, sensation, appearance, pain, sickness, and interference with daily activities, and found statistically significant differences in eating, appearance, and sickness subscales.

Limitations

In this study, QOL measurement on the 7th postoperative day may have biased the scores because the discomfort had decreased by day 7. Another limitation of this study was that neither the patients nor the surgeons were blinded to the use of submucosal dexamethasone.

Future prospects

For a better assessment of the impact of submucosal dexamethasone on postoperative discomfort, studies that evaluate patient response to the PoSse instrument preoperatively and on each postoperative day must be conducted.

CONCLUSION

The administration of a single-dose submucosal injection of dexamethasone after third molar removal is a simple, less-invasive, and cost-effective technique for reducing postoperative signs and symptoms and improving the postoperative QOL. QOL outcome studies measure the

patient's perception and they may serve as an effective guide for the maxillofacial surgeons in framing the expectations of the prospective patients regarding the immediate QOL outcomes after the third molar surgery.

Declaration of patient consent

The authors certify that they have obtained all appropriate participant consent forms. In the form, the participant (s) has/has given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The participants understand that their names and initials will not be published, and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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